Systems Integration

Options Abound When it's time to integrate

by Pan Demetrakakes
Executive Editor

From single machines to entire lines, integration projects require many choices—including who will help.

"Systems integration" is a phrase that covers a lot of ground. Literally, in many cases.

Integration can be as simple as fitting a new machine into an existing line, or as complex as coordinating every packaging line in a plant with other aspects of the plant's operations. It can involve mechanics, electronics, material handling, information systems and more.

Every plant that wants to add, alter or improve any of its packaging machinery will have to grapple with integration issues in one form or another. That means choosing among an array of options, not only of what to integrate, but who will help do it.

Whatever the scope of an integration project, it often requires expertise beyond the scope of the end user—especially at small companies or those that have downsized their engineering staffs. That means one of the first decisions to make is who will be brought in to help with the integration.

For smaller-scale projects, the obvious choice is the machinery suppliers. But for large-scale integration, end users can choose between suppliers and third-party integration specialists.

One of the biggest advantages of the latter is their ability to look at the big picture, says Howard Leary, vice president/engineering of Luciano Packaging Technologies.

"A company like ours, that is basically an engineering company, usually has a broader array of services," Leary says. More than just putting a line together, third-party integrators can help clients work through a concept: "We like to start at the beginning, when the customer knows they need something but they don't know what they need."

Objectivity is another advantage, says Dan Finazzo, manager of the manufacturing systems group at Lockwood Greene.

"We do not align ourselves with any equipment manufacturer, whether it's mechanical or electrical," Finazzo says. "We have the freedom to recommend and specify the appropriate equipment for the appropriate project, unlike an equipment vendor. They tend to want to look in their own backyard first."

Supplier objectivity

But equipment vendors maintain they can be objective, too. R.A. Jones & Co., a supplier of cartoners and other packaging equipment, has had an integration division for more than 10 years. Most of the integration projects it handles will involve Jones equipment, but this is not invariable, says Wayne Uhl, director of integrated services.

"If R.A. Jones does not turn out to be the No. 1-rated piece of machinery [for the application], we will not use an R.A. Jones cartoner," Uhl says. "We could use a competitor."

When it comes to sourcing equipment from outside, many manufacturers who do integration prefer particular suppliers. Raque Food Systems, a maker of fillers and other equipment, is typical; it doesn't have formal partnerships, "but through our experience we know that certain products are better for certain jobs," says marketing director Tim Kent.

Nalbach Engineering Co., another equipment supplier that does integration services, selects equipment suppliers based on both technical capability and their reputation in the industry, says Gary Lange, vice president for sales. Of course, equipment must be compatible in terms of capacity, speed and cost.

"I don't think you want to put Cadillac in with all Hyundais," Lange says. "And I'm not suggesting that it's all Cadillac equipment, either. You have to kind of feel out the customer and understand what his budget constraints are, too."

But in the end, the customer is always right, he says: "In cases where our preferences clash with the customer's preference, we'll utilize the customer's preference, and work to the best of our abilities to accommodate those preferences."

Familiarity with equipment—its own and others'—is one of the biggest advantages a machinery manufacturer has in line integration, Kent says: A completely independent integrator "may be capable, but often they're reinventing things we already know how to do."

Customer prep

No matter who the integrator is, the first steps in the integration process depend on the customer's degree of preparation. Some customers have specifications for machinery, layout and other aspects practically in hand before they start the process. Others deal in general concepts and leave the specifics to the integrator.

"You've got some that come from an end-result perspective: 'I've got this product and I want to start here, and at the end of the day I want to be producing this many pieces per hour at this level of efficiency,'" Uhl says.

Sometimes the integrator can suggest changes to the makeup of the package itself to make it easier to manufacture. This is especially true when the package is unique or unusual, Leary says.

"In a situation like that, they may have an idea of a package, but we still have an opportunity to modify it," he says. "One thing [that we consider] is the package and how manufacturable it is—how amenable to automatic packaging."

In any case, the process often starts with questioning by the integrator, Lange says.

"Customers will come to us with a request, such as, 'I've got these three different container sizes, caps and labels that I want to fill with a given product. We'd like to have you look at putting together a turnkey line.' And then we start probing the customer—what are your requirements for line speeds? How automated do you want this line to be?"

Feasibility study

The first step usually is a feasibility study that takes into account logistical considerations like floor space, throughput efficiencies of the different kinds of equipment under consideration, and other factors. This often yields a preliminary line layout. R.A. Jones will use three-dimensional diagrams and simulation software to present this concept to the client.

Lockwood Greene has developed its own term for the initial plan of a packaging line: conveyor and instrumentation diagram, or C&ID. The phrase plays off "piping & instrumentation diagram" (P&ID), a standard engineering format to describe a manufacturing process.

The C&ID concept reflects Finazzo's belief that material handling is the most important component of packaging line integration. "One of my favorite sayings is that manufacturing is nothing more than material-handling moves occasionally interrupted by a value-added operation," he says. How containers are handled, both within and between machines, dominate the initial planning stages, Finazzo says.

Whatever form the initial diagram takes, once it has been completed, Uhl says, the project can be turned over to the client—assuming that the client wants to take over responsibility for soliciting and evaluating bids. Otherwise, Jones will finalize the layout and develop a full project schedule with milestones. It will work with vendors, hold design review meetings, and generally coordinate all aspects of the integration from the installation commissioning to the site acceptance test.

Sometimes it's not feasible to put lines together for the first time on the client's floor. Nalbach, for instance, prefers to do complete integration and factory acceptance tests in its own facility, in part because many of its customers come from overseas.

"They can see all the equipment successfully running together right in one spot," Lange says. "They don't have to come to Chicago to see the Nalbach filler, go to Milwaukee, Wisconsin, to see the labeler, go to Atlanta, Georgia, to see the capper—go here, there and everywhere."

At its most basic, integration starts with the compatibility of two machines standing next to each other. Integrators must pay attention to such dimensional basics as discharge heights and conveyor widths. Certain interactions can affect the physical distance between machines; a filler and a sealer for a product treated with modified atmosphere packaging, for instance, usually will have to be close together and be especially well-coordinated.

Downtime and line speeds are two of the most important aspects of coordination within a line. One common strategy is to locate the point where interruptions are most likely to occur, build accumulation immediately downstream, and make sure that the equipment downstream is capable of running faster than the beginning of the line.

For instance, a company might want to make frequent label changes with a labeler that takes five minutes to change over. A good strategy would be to install an accumulation table that can accommodate five minutes' worth of containers just after the labeler and let product build there before shutdowns.

Electronics compatibility

One of the things that has made coordinating individual pieces of machinery much easier is the advent of electronics, in both motors and controls. The migration away from purely mechanical drives and linkages to servomotors, steppers and other digital drives has simplified compatibility in many instances.

"It's easier to integrate the all-servo machines than it was to integrate a mechanical machine," says Mike Wagner, a business development manager at Rockwell Automation. "The mechanical machines were complicated couplings and linkages. Today, literally we run one connection from one machine to the other, and we essentially can transmit the master encoder to all the other machines."
That kind of compatibility has simplified the purely mechanical aspects of machine coordination.

"It is now much easier to match output of machine rotations with one another," Lange says. "So when you have one container coming out of the filler, it's going right into the capper, on pitch, on sync, and getting capped, and there's always going to be three containers in between the capper and the filler that are in transit. There's never going to be three for the first 10 minutes, and then after 10 minutes it's three and a quarter containers, and then three and a half, and then three and three-quarters, and then by the end of the day, it's like, 'Holy smokes, I've got six extra bottles here—what am I doing with these things?'"

But while the advent of electronics solves some of the problems of integration, it creates others. Compatibility issues reach a new level when servos, controllers, sensors and other electronic components are involved.

The ultimate goal is what has become a new catchphrase in packaging automation: "Plug and pack." In theory, once optimum compatibility in electronics is achieved, packaging machinery should be as easy to plug into an existing line as a printer into a computer network.

But reaching that level of compatibility will take some doing. The fundamental challenge is to institute communication across the different levels at which data is shared and transferred in a production facility.

The most basic such level is motion control. Servos and other digital drives are much more adaptable than mechanical linkages, but they

must be coordinated with each other electronically. Motion control devices accomplish this coordination.

The next level of data communication takes place between machines—specifically, between their controllers. These devices, commonly programmable logic controllers (PLCs), regulate machinery by accepting and sending signals up and down the line. Linking this input/output (I/O) is a crucial step in line integration.

Integrating even a single piece of new equipment into a new line will almost always require PLC linkup. For instance, someone who buys a print-and-apply case labeler could, in theory, simply trundle it next to the case packer and hook up the print engine to whatever holds the data for the labels. But users who ignore integration at the PLC level do so at their peril, says Jeff Hudson, automated labeling system specialist, Lowry Computer Products.

"If you don't integrate it, you have issues like the machine runs out of labels and the assembly line doesn't know that," Hudson says. "So boxes continue to go by, nothing's being printed and nothing's being put on the box." If the system's PLC is tied into that of the case-packer upstream, the line can slow or shut down until the situation is rectified.

Proper protocol

Before controllers can talk to each other, they must share a common language, called a "communication protocol." Several alternatives are available; their choice will depend on the nature of the physical connections between the controllers, how much information is to be shared and even where the controllers are manufactured.

Rockwell sees Ethernet IP as the protocol most likely to dominate in the future, Wagner says. Not only does it have the capacity to carry large amounts of information, but it can sort that information in a "deterministic" way. That means it can distinguish between data like motion control, which has to flow in real time, and lower-priority data like monitor displays and printer messages.

If "plug and pack" is ever to be accomplished, I/O signals must be standardized in another way: Machines have to be able to communicate their status, and accept similar communication from other machines, in a uniform manner. That has been neglected as packaging machinery has developed, Wagner says.

"In the packaging industry, because of the way the control systems evolved, a lot of it was just spaghetti code," he says. Until relatively recently, PLCs and motion controllers were programmed separately, and had to be coordinated with a complex interface. Now the coordination is much easier; in many instances, it's not even necessary, because the same processor is used as a motion control and a PLC.

Trying to complete the standardization process is OMAC (Open Modular Architecture Controls), a consortium of machinery manufacturers, electronics suppliers, end users and other packaging specialists. OMAC is developing a packaging language called PackML that allows machines to communicate their status—running, stopped, aborted, speed and more—in a standard format.

"Now, when they talk to each other, they'll also know what's going on," Wagner says. "So as that machine upstream keeps trying to feed product in, the machine downstream will have a state of ready. Or maybe it's in a hold or a stop, in which case that machine upstream will know how to communicate."

In theory, a packaging line that runs entirely on PackML would be able to accept any new machinery with a simple connection of PLCs. PackML-enabled machinery started reaching end users early last year.

It's all part of the effort to make integration as easy as possible, Wagner says.

"The end users want to have plug-and-pack," he says. "Bring the machine in, drop it on the floor, connect it to the network and push start and it's running. They don't want to hard-wire anything anymore. They

want the machines to understand each other out of the box.” F&DP